

## Principles of Cognition (Psych & Cog Sci 830:201:01)

### Syllabus

**Meeting Times:** Mondays and Thursdays 12:00 - 1:20

**Recitation (4 credit enrollees only)** Thursdays 10:20-11:25 (Rm 101, Beck Hall (Livingston))

**Room:** Rm 110 LCB

**Professor:** C.R. Gallistel

**TA:** John Wilder

**Office Hours:** *Professor* - Tues & Weds 11:00-12:00 in Psychology A135; by appointment in Nelson B409. *TA:* T10-12, W11-2 in Psychology Annex A106

### Course Summary

Cognitive science is the intersection of psychology, linguistics, computer science and philosophy of mind. Its central doctrine is the computational theory of mind. The goal of this course is to make students conversant with core concepts and principles of this theory: information, representation, computation, intentionality, compositionality, optimization, efficient coding, constrained probabilistic inference (Bayesian inference), and levels of analysis. For a statement of the principles, see the Goal of the Course (separate file).

### Requirements

- 1) Two midterms and a final exam; mostly multiple choice (70%). The questions probe your understanding of the principles and concepts. They require thought. The emphasis is on your understanding of the principles, not on your mastery of the facts, although principles without facts are like skeletons with no flesh.
- 2) Active participation on the course bulletin board, where students post questions and comments on the readings and the lectures and where the professor and the TA and their fellow students respond to the questions and comments. The professor and the TA will pose questions of their own to inspire discussion. Many of these questions will arise from the readings. Active participation requires a minimum of 10 postings. A student's postings are graded by the professor and the TA for their quality (30% of course grade).
- 3) Cognitive science students taking the course for 4 credits do a research paper on one of several topics TBA

### Textbook

Steven Pinker, "How the mind works." Available in paperback from Amazon for \$12.55. This is *much* more readable, more interesting and cheaper(!) than the standard texts. Buy it and read it cover to cover, the earlier in the course the better. Then, revisit portions as they become relevant to the lectures. Other

readings are to be downloaded from the course's Sakai site or accessed via their url.

### **Other readings**

The other readings are of two kinds. Some are "required" (that is, exam questions may be based on material they contain that was not covered in the lectures). Others are urls (in underlined blue links) that may help a student understand better or go more deeply into a given principle or concept. Exam questions will not be based on these readings, but reading them may help a student understand important principles (hence, do better on the exams).

**Final Exam:** Thursday, 12/20, 12:00-3:00

### **Schedule of Lectures**

*This schedule is incomplete: detail--for example, further readings-- will be added as the semester progresses*

#### **Thurs 9/6 History**

Reading: Pinker, Chapter 1

#### **Mon 9/10 History**

Reading: Chomsky: *Reflections on Language*, Chap 1

Turing: *Computing machinery and intelligence*

#### **Thurs 9/13 The Computational Theory of Mind**

Reading: Pinker pp. 5- 10, 21-31. Marr *Vision* pp. 3 -20

Fodor: *The Language of Thought*, Chap 1

Aydede, Murat, "The Language of Thought Hypothesis", The Stanford Encyclopedia of Philosophy (Fall 2010 Edition), Edward N. Zalta (ed.), URL = <http://plato.stanford.edu/entries/language-thought/>

[http://en.wikipedia.org/wiki/Language\\_of\\_thought\\_hypothesis](http://en.wikipedia.org/wiki/Language_of_thought_hypothesis)

#### **Mon 9/17 Levels of Analysis (Aaron Kheifets)**

Reading: Marr, pp. 20-27; Nagel What is it like to be a bat?

Randall C. O'Reilly (2000) *Levels of Analysis*:

<http://psych.colorado.edu/~oreilly/cecn/node11.html>

[http://en.wikipedia.org/wiki/David\\_Marr\\_\(neuroscientist\)](http://en.wikipedia.org/wiki/David_Marr_(neuroscientist))

[http://en.wikipedia.org/wiki/Cognitive\\_science](http://en.wikipedia.org/wiki/Cognitive_science)

**Thurs 9/20** Representations - 1: The represented system and the representing system

Reading: Gallistel, Mental Representations, Psychology of. *International encyclopaedia of the social and behavioural sciences*. N.J. Smelser & P.B. Baltes (Eds.) New York: Elsevier. pp 9691-9695 (in pdf on Sakai)

Thagard, Paul, "Cognitive Science", The Stanford Encyclopedia of Philosophy (Fall 2012 Edition), Edward N. Zalta (ed.), forthcoming URL = <http://plato.stanford.edu/entries/cognitive-science/> - RepCom

**Mon 9/24** Representations - 2: Signals and symbols

**Thurs 9/27** Representations - 3: The necessary connection between the mapping and the algorithms (how you compute it depends on how you represent it and vice versa)

**Mon 10/1** Information: source entropy, signal entropy, receiver entropy

Reading: Pinker, p. 25-27, 65-66, 175-176

Gallistel & King, *Memory and the computational brain*. Chap. 1 Information

**Thurs 10/4** Mutual information and cross information (how much you can learn about X from Y and how much there is to learn, the discrepancy between the state of the world and what you currently know about it)

**Mon 10/8** Review

**Thurs 10/11** *Midterm 1*

**Mon 10/15** Bayesian Inference -1: The distinction between probability and likelihood

Reading: Gallistel & King, Chap. 2, Bayesian Updating

[http://en.wikipedia.org/wiki/Likelihood\\_function](http://en.wikipedia.org/wiki/Likelihood_function)

**Thurs 10/18** Bayesian Inference - 2: The importance of the prior

**Mon 10/22** Bayesian Inference - 3: Examples of its wide use

**Thurs 10/25** Rational decision theory (Aaron Kheifets)

**Mon 10/29** Perception - 1: Distal stimulus->proximal stimulus->percept

Reading: Pinker 5-10, 211-284, 245-248, 268-284

**Thurs 11/1** Perception - 2: The poverty of the stimulus

**Mon 11/5** Perception -3

**Thurs 11/8** Perception - 4

**Mon 11/12** Review

**Thurs 11/15** *Midterm 2*

**Mon 11/19** Learning & Memory -1

Reading: Gallistel & King: Preface

**Tues 11/20** Learning & Memory - 2

**Mon 11/26** Learning & Memory - 3

**Thurs 11/29** Language - 1

**Mon 12/3** Language -2

**Thurs 12/6** Language - 3

**Mon 12/10 Review**